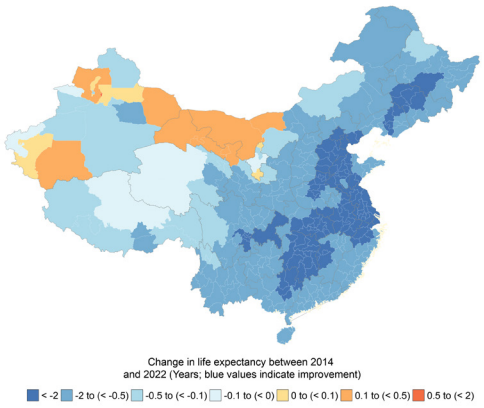
AQLI Air Quality Life Index® | China Fact Sheet

China's fine particulate air pollution ($PM_{2.5}$) has been decreasing since the country announced a "war against pollution" in 2014. This decline has continued through 2022, with pollution levels down by 41 percent compared to 2013 (Figure 1).[1] Due to these improvements, the average Chinese citizen can expect to live 2 years longer as compared to 2013, provided the reductions are sustained. Nevertheless, work remains. While China's overall particulate pollution average is in compliance with its national standard of 35 µg/m³, pollution levels still significantly exceed the World Health Organization (WHO) guideline of 5 µg/m³. As a result, particulate pollution shortens an average Chinese resident's life expectancy by 2.3 years relative to what it would be if the WHO guideline was met.

KEY TAKE-AWAYS

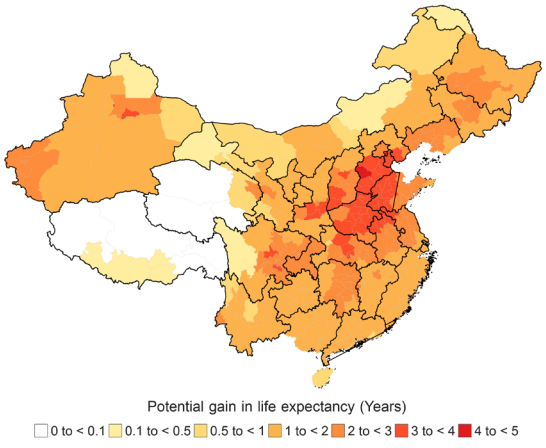
- Despite tremendous progress over the past few years, 99.9 percent of China's 1.4 billion people still continue to live in areas where the annual average particulate pollution level exceeds the WHO guideline. More than 20 percent of the population still lives in areas that exceed China's national pollution standard, though the country's average particulate pollution concentration—28.2 ug/m³ —met the standard in 2022.
- If the areas not complying with China's national standard reduced pollution to meet the standard, an individual living in these areas would live 6 months longer, adding 170.8 million life years to China's overall life expectancy.
- Air pollution is the third highest risk factor for reduced life expectancy in the country next only to high blood pressure and tobacco. While particulate pollution takes 2.3 years off the life of an average Chinese resident, threats like dietary risks and transport injuries take off 1.7 years and 0.4 years off, respectively. (Figure 4).
- Despite a 45 percent reduction in particulate levels in 2022 relative to 2013, the Beijing-Tianjin-Hebei (BTH) region continues to be the most polluted region in Mainland China.[2] If pollution levels in this region were reduced to meet the WHO guideline, an average resident of this region would live 3.2 years longer.

Figure 1 · Improvements in life expectancy due to reduced pollution between 2014 and 2022



Note: Most Chinese residents will see their life expectancy improve (blue) due to recent reductions in particulate pollution, if those reductions persist. Residents living in just two prefectures (orange) are losing years off their life expectancy due to higher particulate pollution in 2022 compared to 2014.

Figure 2 · Potential gain in life expectancy from permanently reducing PM2.5 from 2022 concentration to the WHO guideline



1 This data is based on the AQLI 2022 dataset. All annual average PM2.5 values (measured in micrograms per cubic meter: µg/m³) are population weighted.

2 BTH stands for Beijing-Tianjin-Hebei.

- In Guangdong, the most populous province in China, with a population of approximately 110 million, the average $PM_{2.5}$ concentration is 19.4 μg/m³. Residents here would gain 1.4 years of life expectancy if the $PM_{2.5}$ levels met WHO guideline (Figure 3).
- In China's most polluted prefecture of Shijiazhuang in Hebei Province—a part of BTH region—the average person is losing 4.4 years of life expectancy on average relative to the WHO guideline (Appendix table).
- China's third air pollution control plan aims to reduce $PM_{2.5}$ at the prefecture level by 10 percent by 2025 as compared to the 2020 levels. To meet this target, the $PM_{2.5}$ level for the BTH region would need to decrease by 20 percent, and in the Fenwei Plain by 15 percent by 2025. Beijing's $PM_{2.5}$ level should be controlled below 32 μg/m³ by the year 2025.[3] Meeting these goals would increase the average life expectancy of a Chinese resident by 4 months relative to what it would be if the 2020 levels persisted.

Figure 3 · Potential gain in life expectancy from reducing PM2.5 concentrations from 2022 levels to the WHO guideline in the 10 most populous provinces of China

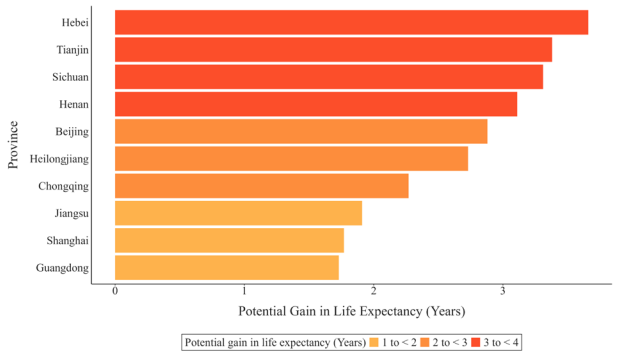
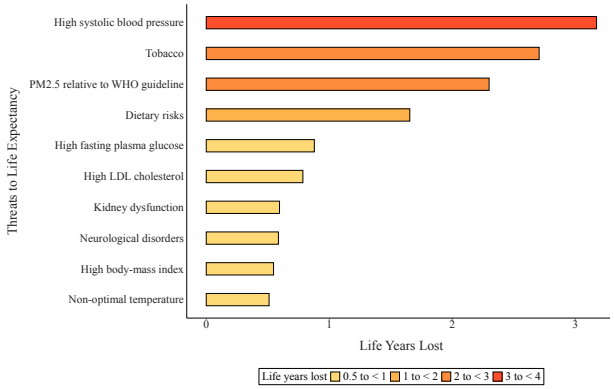


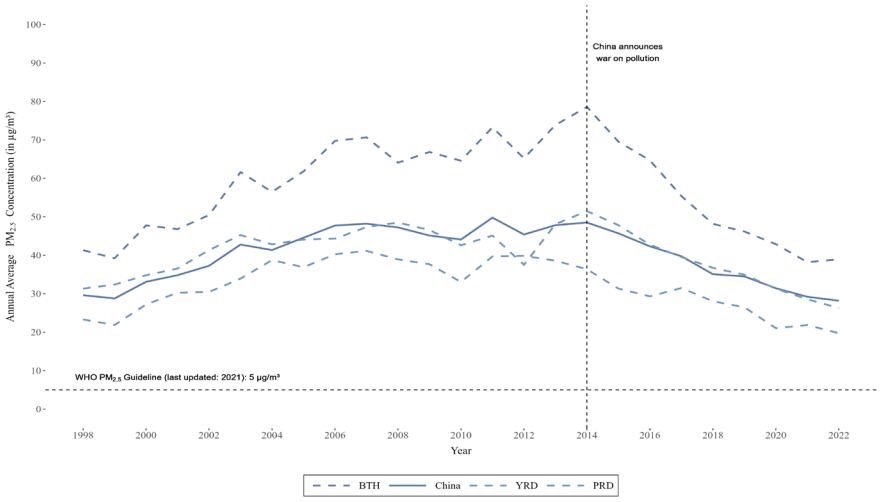
Figure 4 · Top 10 threats to life expectancy in China



Sources: Global Burden of Disease (https://vizhub.healthdata.org/gbd-results/) level-2 causes and risks data and WHO Life Tables (https://apps.who.int/gho/data/node.main.LIFECOUNTRY?lang=en) were combined with the Life table method to arrive at these results. "PM2.5 relative to WHO Guideline" bar displays the reduction in life expectancy relative to the WHO guideline as calculated by latest AQLI (2022) data.

Figure 5.

Annual average $PM_{2.5}$ concentrations in major regions in Mainland China, 1998-2022



Note: PRD stands for Pearl River Delta and it includes the dense network of cities that covers nine prefectures of the province of Guangdong, namely Dongguan, Foshan, Guangzhou, Huizhou, Jiangmen, Shenzhen, Zhaoqing, Zhongshan and Zhuhai and the Special Administrative Regions of Hong Kong and Macau. YRD stands for Yangtze River Delta and it includes Shanghai, Jiangsu and Zhejiang. BTH stands for Beijing-Tianjin-Hebei. It is important to note that our definition of the YRD region includes all regions in the Jiangsu and Zhejiang provinces. Others may define the YRD region differently than how we have defined it in this report.

3 Dialogue Earth. 2023. "New air pollution control plan released" https://dialogue.earth/en/digest/new-air-pollution-control-plan-released/

Potential life expectancy impacts of particulate pollution reductions in the 25 most populous prefectures of China

Prefecture	Population (Millions)	$PM_{2.5}$ concentration 2022 (μg/m³)	Life Expectancy Gains from reducing $PM_{2.5}$ from 2014 concentrations to 2022 concentrations	Life Expectancy Gains from reducing $PM_{2.5}$ concentrations from 2022 Concentration to the WHO Guideline of 5 μg/m³	Life Expectancy Gains from reducing $PM_{2.5}$ concentrations from 2022 Concentration to the National Standard of 35 μg/m³
Chongqing	30.5	28.2	2.1	2.3	0
Shanghai	24.4	23	2.2	1.8	0
Beijing	20.8	34.4	3.9	2.9	0
Chengdu	14.2	38.8	1.6	3.3	0.4
Tianjin	13.7	39.5	3.7	3.4	0.4
Guangzhou	13.4	22.6	1.8	1.7	0
Baoding	11.8	42.4	5.2	3.7	0.7
Harbin	11.3	32.8	2.6	2.7	0
Suzhou	11	24.5	3	1.9	0
Nanyang	10.9	36.7	1.9	3.1	0.2
Shijiazhuang	10.8	49.9	4.8	4.4	1.5
Shenzhen	10.8	17.4	1.5	1.2	0
Linyi	10.6	34.9	2.3	2.9	0
Wuhan	10.3	35	3.5	2.9	0

Prefecture	Population (Millions)	PM2.5 concentration 2022 (μg/m³)	Life Expectancy Gains from reducing $PM_{2.5}$ from 2014 concentrations to 2022 concentrations	Life Expectancy Gains from reducing $PM_{2.5}$ concentrations from 2022 Concentration to the WHO Guideline of 5 μg/m³	Life Expectancy Gains from reducing $PM_{2.5}$ concentrations from 2022 Concentration to the National Standard of 35 μg/m³
Handan	9.7	42.6	3.7	3.7	0.8
Weifang	9.6	34	2	2.8	0
Zhoukou	9.5	40.5	1.8	3.5	0.5
Wenzhou	9.4	22.3	1.6	1.7	0
Hangzhou	9.4	25.3	3.1	2	0
Xi'an	9.1	45	1.2	3.9	1
Zhengzhou	9.1	40.2	2.9	3.5	0.5
Xuzhou	9.1	40	2.2	3.4	0.5
Qingdao	9.1	26.5	2	2.1	0
Ganzhou	8.9	17.8	1.9	1.2	0
Heze	8.8	42	2.2	3.6	0.7

ABOUT THE AIR QUALITY LIFE INDEX (AQLI)

The AQLI is a pollution index that translates particulate air pollution into perhaps the most important metric that exists: its impact on life expectancy. Developed by the University of Chicago's Milton Friedman Distinguished Service Professor in Economics Michael Greenstone and his team at the Energy Policy Institute at the University of Chicago (EPIC), the AQLI is rooted in research that quantifies the causal relationship between long-term human exposure to air pollution and life expectancy. The Index then combines this research with hyper-localized, satellite measurements of global particulate matter ($PM_{2.5}$), yielding unprecedented insight into the true cost of pollution in communities around the world. The Index also illustrates how air pollution policies can increase life expectancy when they meet the World Health Organization's guideline for what is considered a safe level of exposure, existing national air quality standards, or user-defined air quality levels. This information can help to inform local communities and policymakers about the importance of air pollution policies in concrete terms.

Methodology:The life expectancy calculations made by the AQLI are based on a pair of peer-reviewed studies, Chen et al. (2013) and Ebenstein et al. (2017), co-authored by Michael Greenstone, that exploit a unique natural experiment in China. By comparing two subgroups of the population that experienced prolonged exposure to different levels of particulate air pollution, the studies were able to plausibly isolate the effect of particulate air pollution from other factors that affect health. Ebenstein et al. (2017) found that sustained exposure to an additional 10 μg/m3 of PM_{10} reduces life expectancy by 0.64 years. In terms of $PM_{2.5}$, this translates to the relationship that an additional 10 μg/m3 of $PM_{2.5}$ reduces life expectancy by 0.98 years. This metric is then combined with sea-salt and mineral dust removed satellite-derived $PM_{2.5}$ data. All 2022 annual average $PM_{2.5}$ values are population-weighted and AQLI's source of population data is https://landscan.ornl.gov/. We are grateful to the Atmospheric Composition Analysis Group, based at the Washington University in St. Louis for providing us with the satellite data. The original dataset can be found here: https://sites.wustl.edu/acag/datasets/surface-pm2-5/. To learn more deeply about the methodology used by the AQLI, visit: aqli.epic.uchicago.edu/about/methodology.